[Document] SPECIFICATION

[Title of the Invention] METHOD FOR MANUFACTURING GLASS BASE MATERIAL FOR OPTICAL FIBER

[What is claimed is]

[Claim 1] A method for manufacturing a glass base material for an optical fiber, characterized in that, in a transparent-vitrifying process for dehydrating and sintering a porous glass base material, after a temperature of a reactor for performing a sintering process is increased and a heat zone of the reactor attains a temperature of the sintering process, and after a predetermined time has passed, the porous glass base material is moved to the heat zone and then the sintering process is started.

[Claim 2] A method for manufacturing a glass base material for an optical fiber according to claim 1, wherein, after the heat zone of the reactor attains a temperature of the sintering process and a predetermined time has passed, when the porous glass base material is moved to the heat zone and then the sintering process is started, the predetermined time (elapsed time) T satisfies a following expression:

$$T \geq \pi(R^2L - r^2l)/4Q$$

[R: an inner diameter (m) of the reactor, L: a length (m) of the reactor, r: an outer diameter (m) of the porous glass base material body, l: a length of a body, Q: a capacity (m^3) of the reactor].

[Claim 3] A method for manufacturing a glass base material for

an optical fiber, characterized in that, in a transparent-vitrifying process for dehydrating and sintering a porous glass base material, after a temperature of a reactor for performing a sintering process is increased and a heat zone of the reactor attains a temperature of the sintering process, and after a process gas is supplied in the reactor, a predetermined time is kept, and the gas in the reactor is replaced with the process gas sufficiently, the porous glass base material is moved to the heat zone, and the sintering process is started.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to a transparent-vitrifying process of dehydrating and sintering a porous glass base material and to a method for manufacturing a glass base material for an optical fiber having the evenness of characteristics in the longitudinal direction.

[0002]

[Description of the Related Art]

Conventionally, in the event that a porous glass base material is dehydrated, sintered, and transparent-vitrified using a sintering apparatus, a method, in general, in which the porous glass base material is heated in an He atmosphere and the transparent-vitrifying process is performed after a residual gas is converted to He, is adopted. For example, it is described in

the Gazette, Toku-Kai-Sho 64-72936, that it is suppressed to produce the bubble by converting the residual gas to He in a manner of taking enough time, although a cause to produce a bubble is made if sintering is performed under a condition in which a residual gas exists in the porous glass base material. However, in the glass base material for an optical fiber obtained in this method, when dehydrating and sintering processes are performed, the portion where the process has not been performed is found in the side where a sintering process of the porous glass base material is started and the unevenness of the process might appear.

[0003]

Specifically, there is a trend in which the glass base material for the optical fiber, in recent years, is more and more enlarged and lengthened. In accordance with such a trend, there is a problem in which it would take a long time for a chloric gas to reach in to a core portion of the porous glass base material when dehydrating and sintering processes are performed using a process gas, such as a chloric gas, for example.

[0004]

[Problems to be Solved by the Invention]

The object of the present invention is to provide a method for manufacturing a glass base material for an optical fiber having no unevenness of a process, which can sufficiently carry a process gas in a core portion of a porous glass base material and can perform dehydrating and sintering processes in an efficient manner.

[0005]

[Means to Solve the Problems]

The inventors have assiduously discussed the above-mentioned object in accordance with elongation and solved it as a result. That is to say, the invention of claim 1 is a method for manufacturing a glass base material for an optical fiber, characterized in that, in a transparent-vitrifying process for dehydrating and sintering a porous glass base material, after the temperature of a reactor for performing a sintering process is increased and the heat zone of the reactor attains the temperature of the sintering process, and after a predetermined time has passed, the porous glass base material is moved to the heat zone, and then the sintering process is started.

[0006]

In the invention of claim 2, it is preferable to set, after the heat zone of the reactor attains the temperature of the sintering process and a predetermined time has passed, when the porous glass base material is moved to the heat zone and then the sintering process is started, the predetermined time (elapsed time) T satisfies a following expression

$$T \geq \pi(R^2L - r^2l)/4Q$$

[R: an inner diameter (m) of the reactor, L: a length (m) of the reactor, r: an outer diameter (m) of the porous glass base material body, l: a length of a body, Q: a capacity (m^3) of the reactor].

[0007]

The invention of claim 3 is a method for manufacturing a glass base material for an optical fiber, characterized in that, in a transparent-vitrifying process for dehydrating and sintering a porous glass base material, after a temperature of a reactor for performing a sintering process is increased and a heat zone of the reactor attains the temperature of the sintering process, and after a process gas is supplied in the reactor, a predetermined time is kept, and the gas in the reactor is replaced with the process gas sufficiently, the porous glass base material is moved to the heat zone, and the sintering process is started.

[0008]

[Preferred Embodiments of the Invention]

According to the inventors, after a top end portion of an elongated porous glass base material is moved to a vicinity of a heat zone and the heating zone of the reactor has attained sintering temperature, a process at the top portion of the porous glass base material in the side in which it is started to sinter is progressed in advance by leaving at the position thereof for a predetermined time, it is started to perform a sintering process of the porous glass base material, and thus it is possible to eliminate a process irregularity in the side in which it is started to sinter of the porous glass base material.

[0009]

The inventors of the present invention have found that, when the porous glass base material is moved to the heat zone and then

the sintering process is started after the heating zone of the reactor has attained a sintering temperature and then a predetermined time has passed, a desirable time of the above-mentioned predetermined time (elapsed time) T differs from the minor diameter, the length, and the volume of the reactor, the major diameter of the base material, and the length of the large diameter portion of the base material; and have solved a problem that occurred at the time of sintering by setting the elapsed time T as satisfying an expression $T \geq \pi(R^2L - r^2l)/4Q$.

[0010]

Furthermore, after the heating zone of the reactor has reached the sintering temperature, the sintering temperature is kept for the prescribed period until the atmosphere gas is thoroughly replaced with the treatment gas, for instance Ar, and the treatment gas has adequately reached up to the core of the base material, then the porous glass base material is moved to the heat zone and the sintering process is performed.

[0011]

As a result of the sintering process described above, the beginning portion where conventionally the sintering process is insufficient has less heating irregularity in the longitudinal direction because the base material starts moving after a sufficient period has elapsed from the time when the sintering temperature has been attained, so that the base material for optical fibers which have stable characteristics can be manufactured.

[0012]

[Embodiment]

(First embodiment)

A sintering process to a large size porous glass base material was carried out, using a sintering apparatus as shown in Fig. 1.

At first, a large scale porous glass base material 1 was set into a reactor 2, and then the temperature of the reactor 2 was increased; after a heat zone 3 of the reactor 2 reached the sintering temperature, the process waited for thirty minutes for the elapsed time (T); following that, the porous glass base material 1 was moved into the heat zone 3, and the sintering process was started; and then the dehydration and transparent-vitrifying processes were carried out. Here, in Fig. 1, the numeral 4 is a hanging tool, the numeral 5 is an intake bulb, the numeral 6 is an exhaust bulb, and the numeral 7 is a pressure gauge.

With respect to the base material thus obtained, a refractive index difference Δn (%) from the reference index was measured along the length direction. The result thereof is indicated in Fig. 2. In Fig. 2, the symbol Δ represents the measured values of the present embodiment.

Furthermore, after the heat zone 3 of the reactor 2 reached the sintering temperature, the temperature thereof was maintained for 30 minutes and the atmospheric gas was sufficiently replaced with the Ar gas; then it started to move the porous glass base material 1 to the heat zone 3, and the sintering process was

performed; and in this case, the same results were also obtained.

[0013]

(First comparative embodiment)

A porous glass base material was sintered using the same apparatus as the first embodiment for comparison.

After the porous glass base material is installed in the apparatus; after the temperature of the reactor was increased and the reactor heated up to the sintering temperature; and the porous glass base material is moved to the heat zone without delay, the sintering process was performed, and thus the porous glass base material for an optical fiber was obtained. With respect to the base material thus obtained, a refractive index difference Δn(%) from the reference index was measured, and the result thereof is shown in Fig. 2. In the figure thereof, a curve connecting the symbols "○" represents the measured values of the present comparative embodiment.

[0014]

As is apparent from Fig. 2, the glass base material of the first embodiment had insufficient processing at the beginning of sintering but the uniform refractive index in the length direction, and was superior than the conventional ones.

[0015]

[Advantages of the Invention]

In the present invention, the top portion of a base material near a heat zone is processed in advance by starting the sintering

process after a reactor attains the temperature of a process and is waiting for a predetermined time; and after that, it is possible to carry a process gas to a core portion of a porous glass base material by processing a body portion at a fixed speed, and it is possible to manufacture the base material having unevenness of a process in the longitudinal direction and less variation of characteristics.

[Brief Description of the Drawings]

[Fig. 1] A schematic illustration of a sintering apparatus.

[Fig. 2] A graph showing a distribution of a refractive index difference Δn(%) of a glass base material of an optical fiber in the longitudinal direction.

[List of the Elements]

1 Porous glass base material

2 Reactor

3 Heat zone

4 Hanging tool

5 Intake bulb

6 Exhaust bulb

7 Pressure gage

[Document] ABSTRACT

[Summary]

[Object] To provide a method for manufacturing a glass base material for an optical fiber having no unevenness of a process, in which it is possible to spread a process gas to a core portion of a porous glass base material and to perform dehydrating and a sintering reaction effectively.

[Means for Achieving the Object] A transparent-vitrifying process for dehydrating and sintering a porous glass base material characterized in that, after the temperature of a reactor for performing a sintering process is increased and a heat zone of the reactor attains the temperature of the sintering process, and after a predetermined time has passed, the porous glass base material is moved to a heat zone and then the sintering process is started.

[Selected Figure] None

[Document name] Drawings

[Fig. 2]